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The impacts of ict on leisure activities and travel: A conceptual exploration

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Abstract. This paper offers a conceptual exploration of the potential impacts of ICTs on leisure activities and the associated travel. We start by discussing what leisure is and is not. We point out that the boundaries between leisure, mandatory, and maintenance activities are permeable, for three reasons: the multi-attribute nature of a single activity, the sequential interleaving of activity fragments, and the simultaneous conduct of multiple activities (multitasking). We then discuss four kinds of ways by which ICT can affect leisure activities and travel: the replacement of a traditional activity with an ICT counterpart, the generation of new ICT activities (that may displace other activities), the ICT-enabled reallocation of time to other activities, and ICT as a facilitator of leisure activities. We suggest 13 dimensions of leisure activities that are especially relevant to the issue of ICT impacts: location (in)dependence, mobility-based versus stationary, time (in)dependence, planning horizon, temporal structure and fragmentation, possible multitasking, solitary versus social activity, active versus passive participation, physical versus mental, equipment/media (in)dependence, informal versus formal arrangements required, motivation, and cost. The primary impact of ICT on leisure is to expand an individual's choice set; however whether or not the new options will be chosen depends on the attributes of the activity (such as the 13 identified dimensions), as well as those of the individual. The potential transportation impacts when the new options are chosen are ambiguous.

1. Introduction

There is widespread recognition that the growing use of information and communication technology (ICT)[1] can affect the demand for personal travel in a variety of ways. For one thing, because it offers alternative means of conducting various kinds of activities, ICT may substitute for going to a specific location to conduct the activity, and thus eliminate the travel to that location. In some cases, however, ICT-based activities may not directly and consciously replace location-based activities; they may simply be new

activities that would not have occurred otherwise. In those cases, there may be no direct impact on travel (although there may often be indirect impacts). In yet other instances, ICT may in fact stimulate the demand for new location-based activities, which generate travel. The literature (e.g., Salomon 1986; Mokhtarian 1990) refers to these outcomes as substitution, neutrality, and complementarity, respectively. Another possibility is also identified: modification, in which travel is neither generated nor replaced, but altered in some way as a consequence of ICT[2].

A number of studies have examined the adoption of ICT and its impacts on personal travel at a relatively general, overall level (e.g., Choo and Mokhtarian forthcoming; Day 1973; Albertson 1977; Salomon 1986; Mokhtarian 2002). It is more common, however, to consider the adoption and transportation impacts of ICT in the context of a particular kind of activity. For example, a great deal has been written about the adoption of telecommuting and its impacts on travel (e.g., Mokhtarian 1998). Smaller bodies of work exist with respect to the demand for teleconferencing and its effects on business travel (e.g., Bennison 1988), and the impacts of the burgeoning growth in teleshopping or e-commerce on shopping travel (e.g., Salomon & Koppelman 1988; Williams and Tagami 2002; Farag et al. 2003; Mokhtarian 2004; Ferrell 2005).

Travel behavior researchers (e.g., Reichman 1976) have traditionally divided trip purposes (and hence activity types) into three categories: subsistence or mandatory (work and work-related), maintenance (shopping, medical, banking, other personal business), and discretionary or leisure (compare the parallel trichotomy of "compelled," "personal," and "free" activities described by Delespaul et al. 2004). It is not surprising that initial attention has focused on the effects of ICT on travel for mandatory and maintenance activities, while discretionary or leisure activities have received relatively little attention from this perspective (Handy & Yantis 1997 offer one exception). Yet leisure is by no means an insignificant segment of total activity. In many studies, discretionary purposes account for a third to a half of total personal travel (ECMT 2000; Anable 2002; Götz et al. 2002). There seems to be growth not only in the importance that people place on leisure (e.g., Snir & Harpaz 2002) and in the amount of time devoted to leisure related activities, but also in their diversity of type (Heinze 2000) and spatial location (Schlich et al. 2004). The European Council of Ministers of Transport (ECMT 2000, p. 182) notes that growth in leisure travel and activities can be attributed to three factors: "rising standards of living, earlier retirement and the trend towards shorter working hours." Thus, it can be expected that to the extent economic prosperity continues to rise worldwide, the demand for discretionary activities and their associated travel will increase.

Given the current and future importance of leisure to humankind, therefore, it is relevant to examine the potential impacts of ICTs on this category of activities and hence on the associated travel. The purpose of this paper is to offer a conceptual exploration of those impacts. By analyzing the possible types of impacts of ICT on leisure, and classifying leisure activities according to factors that are relevant to understanding those impacts, we hope to provide a conceptual framework from which future empirical studies can benefit.

The organization of this paper is as follows. In the following section, we explore various issues related to the definition and classification of leisure activities, including three reasons why the boundaries between leisure and other kinds of activities are porous. In Section 3 we discuss four kinds of ways by which ICT can affect leisure activities, and speculate on the general nature of the concomitant travel impacts of those effects. We further suggest 13 dimensions to leisure activities that are especially relevant to the issue of ICT impacts, and crosstabulate those dimensions against the four types of ICT impacts. Section 4 offers some concluding remarks, including suggested directions for further research.

2. What is leisure?

At first glance the concept of "leisure" – comprising social, recreational, and entertainment activities – is apparently well-understood. Numerous scholars have noted, however, that defining leisure is not at all as straightforward as might be initially assumed (e.g., Howe & Rancourt 1990). In this section we review and critique several definitions of leisure and briefly mention a number of bases for classifying leisure activities that have appeared in the literature. We then discuss reasons why leisure is difficult to define, by highlighting three ways in which the boundaries between leisure and other types of activities are not crisp.

2.1. *Definitions of leisure and classifications of leisure activities*

The literature contains a number of definitions of leisure. For example, the 130 Australian adolescents studied by Passmore and French (2001) indicated that freedom of choice and enjoyability were crucial to an activity being considered leisure. Similarly, Tinsley et al. (1993, p. 447) define four necessary characteristics for a leisure experience to occur: "The individual must perceive the activity as (a) freely chosen, (b) intrinsically satisfying, (c) optimally arousing, and (d) requiring a sense of commitment." But clearly at least the latter three characteristics can apply to subsistence and maintenance

activities as well as leisure, and even the first characteristic, freedom of choice, can apply to numerous tasks within an individual's job or to certain aspects of maintenance activities. Conversely, it seems rather strict *not* to consider an activity such as accompanying a spouse to a ball game to be leisure if the individual does not entirely freely choose it, or is not fully "committed" to it or "aroused" by it (see, e.g., Kelly 1978).

Meurs and Kalfs (2000, p. 128) define "leisure time" as "all the time a person does not devote to ensuring their *[sic]* future welfare in a broad sense." They indicate that this definition thus excludes activities associated with generating income, running a household, and maintaining physical well-being. They further define "leisure travel" as "all journeys not specifically made with the purpose of providing for the person's future welfare or even for sustaining a normal life." In other words, "there is no future penalty for not making these journeys." Yet these definitions also seem restrictive. Leisure activities should certainly be considered essential to one's psychological welfare, i.e., welfare "in a broad sense," with a corresponding psychological penalty for their complete neglect. And the exclusion of activities that support physical well-being would eliminate a large category of recreational activities, such as participatory sports or exercise, that would normally be classified as leisure.

Interestingly, although they can be more readily *de*ferred or "compressed" than can subsistence or maintenance activities, leisure activities are seemingly *less* readily *trans*ferred than the other two types.[3] Work and maintenance activities are considered essential to the individual's physical well-being (although these activities can also make an important contribution to one's psychological well-being). As such, an individual can receive similar *physical* benefits from outsourcing many of the latter two types of activities to other individuals (e.g., by marrying a person who supports the household financially, or by hiring domestic help). In contrast, since the main contribution of leisure activities is to psychological well-being (although recreational activities can also support the physical dimension, as mentioned above), the individual generally does not benefit by outsourcing leisure to others[4]. Thus, ironically, it is more essential to our well-being that we personally engage in leisure activities than that we personally engage in mandatory or maintenance activities.

Classification systems related to leisure activities and travel can be found in a number of different contexts, including the literatures related to travel, activity analysis, time use, and leisure. For example, there are some interesting taxonomies based on the orientation of the individual toward leisure in general (Snir & Harpaz 2002); personal values, personality, and lifestyle (Madrigal 1995; McGuiggan 2000; Lanzendorf 2002); or the purchase of leisure activities (Reid & Crompton 1993). A number of studies classify leisure activities themselves, based on the nature of the activity (Passmore & French 2001);

its purpose (US DOT 2003); objective characteristics of the activity (Meurs & Kalfs 2000; Bhat and Lockwood 2004); or individual values or psychological needs (Tinsley & Eldredge 1995).

The latter study is particularly relevant to the current context. Starting with a list of 82 leisure activities and an empirical rating of each leisure activity for eleven different psychological benefits, Tinsley and Eldredge used cluster analysis to define 12 classes of leisure activities. The psychological basis of these classes is appealing in that it might provide a convenient way of hypothesizing which kinds of leisure activities are more likely to be impacted by ICT and in what ways. For example, "agency" activities (such as bicycling, swimming, weightlifting) involve physical exertion that is not required for ICT-based activities. Activities fulfilling the "novelty" (camping, gardening), "belongingness" (performance arts and sports), and "sensual enjoyment" (eating out, socializing) needs also seem unlikely candidates for substitution (the Category 1 effect of ICT discussed in Section 3 below). For all of these activity classes, however, ICT may play an important role in managing travel and may even generate travel (the Category 4 effect). Activities fulfilling other needs, such as cognitive stimulation (art galleries, puzzles), self-expression (quilting, stamp collecting), and creativity (cooking, painting), do not so clearly necessitate travel to begin with, in which case ICT may provide a new dimension to the participation in these activities (the Category 2 effect).

2.2. *Permeability of boundaries between leisure and other activities*

One reason for the nebulous nature of the concept of leisure is that the boundaries between leisure, mandatory, and maintenance activities can be quite permeable. This permeability occurs in three different ways — the first conceptually intrinsic to how the individual perceives an activity, the second largely facilitated by ICT, and the third often but not exclusively associated with ICT.

2.2.1. *One activity, multiple aspects*

The first basis for the permeable boundaries between activity types is that intrinsically, many activities possess characteristics of more than one of the conventional three categories (Shaw 1985; Tinsley et al. 1993; Meurs & Kalfs 2000; Götz et al. 2002). This can be for a combination of three different reasons: (1) The same activity may be experienced differently by different people; (2) the same activity may be experienced differently by the same person at different times; and (3) an activity for a single person at a single time may mix aspects of multiple categories.

Examples of the general principle come readily to mind: cooking, gardening, and home repair could be considered maintenance activities, but are forms of recreation for many people. Child care can be quite entertaining under the right circumstances (Shaw 1984). Work-related travel and even commuting have some discretionary aspects for many (Mokhtarian et al. 2001; Redmond & Mokhtarian 2001; Ory et al. 2004). Hochschild (1997) points out that for many people, in contrast to the stereotype of the dog-eat-dog work world from which home is a serene refuge, work (where we interact with mature professionals who value our contributions) is a welcome escape from home (where we interact with needy and demanding family members). Howe and Rancourt (1990, p. 398) note that "[a] generally accepted theme of the psychology of leisure literature is that some people do find personal meaning and do experience freedom and leisure in work."[5] And the recreational/entertainment qualities of shopping (again, for some people) are well-recognized (Tauber 1972; Salomon & Koppelman 1988). Even within the leisure category itself, an activity may have multiple characteristics. When one goes to a ball game with friends, is the activity social, or entertainment? The answer probably affects the activity choice process, including the choice set of perceived alternatives: if the primary motivation is social, one may first decide to get together with friends, and then choose an activity around which to organize the gathering, whereas if the primary motivation is entertainment, one may first decide to attend the ball game and then see who else is able to join.

This discussion speaks to the types and degrees of various motivations for undertaking a given activity, which may differ from what the activity "label" itself would stereotypically imply (e.g., work is a necessary evil; leisure is an optional good). Understanding those motivations is important for analyzing the leisure activity engagement decision process, and the role of ICT in that process. For example, Handy and Yantis (1997) hypothesize that the more chore-like the activity (i.e., the less that a mandatory or maintenance activity is viewed as having leisure overtones), the greater the likelihood of in-home substitution for the out-of-home version of that activity.

On the other hand, we are wary of endowing a mandatory or maintenance activity with leisure qualities simply because it can be pleasant. Meurs and Kalfs (2000) consider enjoyment to be an important element of the definition of leisure time, and it is tempting to equate enjoyment with leisure, suggesting that to the extent that mandatory or maintenance activities are enjoyed, they contain elements of leisure. But that may confuse the concepts of "positive utility" and leisure: a job (such as stockbroker or surgeon) can be enjoyable, stimulating, or fulfilling without being "leisurely." Conversely, not all leisure activities may be enjoyable or relaxing: one may visit relatives but be miserable the entire time, or one may go to a gym in order to stay

physically fit but consider it "torture." We could say that a given activity constitutes leisure to people for whom it is enjoyable (see, e.g., the brief review of literature on "leisure as a state of mind" in Howe & Rancourt 1990), whereas to those for whom it is not, it constitutes a form of maintenance – whether physical maintenance in the case of the gym, or social maintenance in the case of visiting family out of duty. But relying on subjective motivations as the basis for classifying the same activity differently for different people is not very practical for the large scale data collection and analysis needed for regional travel and activity modeling (although it may well be appropriate for more exploratory studies of activity and travel behavior, and as we discuss below, it is relevant for understanding activity choices in general and modeling ICT impacts on leisure travel in particular).

2.2.2. *Multiple types of activities fragmented and sequentially interleaved*
Second, the boundaries between activity types are blurry due to what Couclelis (2000) refers to as the increasing fragmentation of activities, generally made possible by ICT. Whereas before, work, shopping, and leisure activities took place more or less in undivided blocks of time at specialized locations, we now see such activities broken into smaller chunks, interspersed with fragments of other activities, and spread across a larger number of locations. For example, we shop from the Internet or play computer games during a break at the office, and work from home in the evenings (perhaps interwoven with family interaction activities). We send and answer e-mail while on vacation, and engage in sightseeing activities while on business trips (e.g., ECMT 2000 points to the rise in "business tourism").[6] This increasing fragmentability is also expected to have impacts on activity selection and scheduling, and the associated travel. For example, one may choose to watch a movie on DVD rather than in the theater precisely because the DVD can be stopped and started at will, and therefore woven into other activities at home rather than requiring the commitment of a larger block of time and perhaps a separate trip.

2.2.3. *Multiple types of activities simultaneously overlapped (Multitasking)*
The third way in which boundaries between activity types are porous is simply due to multitasking, a case in which fragments of multiple activities of different kinds actually overlap.[7] One may watch television (leisure) while doing a routine work task (mandatory) at home in the evening, or while cooking dinner (maintenance). One may phone a friend while travelling home from work, make work-related calls while watching one's child play soccer, or receive a call while eating with family or friends. Here again, the ability to multitask may affect one's choice of activity mode, location, and timing.

2.2.4. *Implications*
The blurry boundaries between various leisure activities and between leisure and non-leisure activities raise methodological complications. We have previously mentioned the impracticality of classifying the same activity as leisure or maintenance depending on one's motivation for undertaking it or enjoyment of it. Data collection and analysis are also inherently complicated by the presence of fragmentation and multitasking among multiple activity types and subtypes within a short time period.

In sum, we are left with the sense that the more closely the concept of leisure is examined, the more slippery it becomes. Although the considerations discussed above are important, as a pragmatic (if somewhat unsatisfying) solution to the general question of defining leisure we may simply conclude, as US Supreme Court Justice Potter Stewart said about pornography, that we may not know how to define it, but we recognize it when we see it. Of course, empirical studies of leisure will ordinarily need to be more specific than this, and that can be accomplished by narrowing the definition for any particular investigation in ways that will best fit the objectives of that study (Samdahl 1988).

3. Relationships of ICT to leisure

In this section, we explore the relationships of ICT to leisure activities in depth. First, we discuss four kinds of ways by which ICT can affect leisure activities and travel. Then, in Table 2 we present 13 dimensions to leisure activities that are especially relevant to the issue of ICT impacts.

3.1. *Four types of impacts of ICT on leisure*

The four types of effects that ICT may have on leisure activities and travel are summarized in Table 1.[8] All four types have the result of increasing the individual's choice set, which can then be acted upon in several different ways. In the subsections below, we discuss each of these types of impacts in turn.

3.1.1. *Replacement of traditional leisure activity with ICT-based counterpart*
Most directly, ICT may present an alternative way of conducting a leisure activity, which will be chosen if the net utility of the ICT-based form of the activity exceeds that of the other forms. Clearly, to the extent that ICT-based forms are chosen over location-based forms of an activity, travel is likely to be reduced. However, the fact that movie theatres continue to

Table 1. Types of impacts of ICT on leisure activities.

	1. Choice between ICT-based v. traditional activity (replacement)	2. Generation of new ICT-based activities (displacement)	3. ICT-enabled reallocation of time to other activities	4. ICT as enabler/ facilitator/modifier of activities
Mechanism(s) through which effect occurs	•ICT-based activity offers higher net utility than the alternatives	• new ICT-based activities are adopted -new activities overlay others (multitasking); no change in other time allocation; or -new activities crowd out others, reducing time spent on other activities	• time saved through using ICT for another activity is applied to new activity(ies) • money saved through using ICT for another activity is applied to new activity(ies) • ICT increases effective supply of travel, reducing travel times	• more flexible time management in the face of relaxation of spatial &/or temporal constraints (internal or external) • more information about availability of options • ability to save money (directly)
Typical media	• TV • audio (radio, CD, etc.) • DVD • computer, stand-alone • computer, networked • mobile phone/PDA, stand-alone • mobile phone/PDA, networked	• TV • audio (radio, CD, etc.) • DVD • computer, stand-alone • computer, networked • mobile phone/PDA, stand-alone • mobile phone/PDA, networked	• TV • audio (radio, CD, etc.) • DVD • computer, stand-alone • computer, networked • mobile phone, stand-alone • mobile phone, networked • audio- or videoconferencing	• computer, networked • mobile phone/PDA/pager, networked
Time scale	short-term	medium-term	short-term	short-term medium-term
Likely effect(s) on travel	substitution	substitution	substitution generation	modification generation substitution

thrive despite early predictions that people would prefer the home-based entertainment offered by television is only one indication that ICTs' impacts on engagement in activities and travel may not be simply that of substitution. Clearly, there are many indications that complementarity is a viable option, one that is all the more viable as ongoing cost reductions and miniaturization increase the number and portability of leisure-related technologies (consider the progression from the Sony Walkman, to portable CD players, to multi-functional mobile phones).

As has been suggested elsewhere with respect to ICT-based alternatives to work (Salomon & Salomon 1983) and shopping (Salomon & Koppelman 1988), an important reason why substitution does not always occur to the extent expected is that the ICT-based alternatives are often not desirable substitutes to the individual decision-maker at all. In the context of leisure activities, for example, screen size, popcorn, chained activities en-route to or from a theatre, seeing people and being seen, sharing an experience with a crowd, and (theoretically) devotion of uninterrupted time, all make watching a movie at the cinema a different activity than doing so at home (Handy & Yantis 1997).

From a transportation perspective, the cardinal question is, to what extent will or can the use of ICT change the behavior of individuals in time and space? To explore this issue, we have mapped the range of several leisure activities on a two dimensional diagram, with time and space ranging from dependence to independence, respectively. Thus, in Figure 1, the lower left quadrant represents "old" activities, both time- and location-dependent, whereas the upper right quadrant represents the activities that are independent of time and location (positions of activities are only approximate).

Some leisure activities are fixed in space (such as hiking in a certain area[9]) or time (a Christmas-based family visit), and hence cannot readily be altered by ICT. Other leisure activities (such as woodworking) may not be tied to the intrinsic geography of a place, but to equipment or supplies that are stored there – these also are less amenable to ICT alteration. Other activities (such as reading a book), falling in the upper right quadrant, are already both location and time independent, which also renders them less likely to be affected by ICT.

An arrow connects each of the activities in the lower left quadrant to its ICT-based counterpart. Generally, these arrows point in a diagonal direction, right and up, implying greater flexibility in time and space. The arrowhead designates the frontier of the expanded choice set, with possible intermediate combinations in between. Some activities in Figure 1 are shown to have two arrows, indicating different impacts of ICT. For a baseball game, for example, one possible ICT application allows one to hear on the radio, or see on TV,

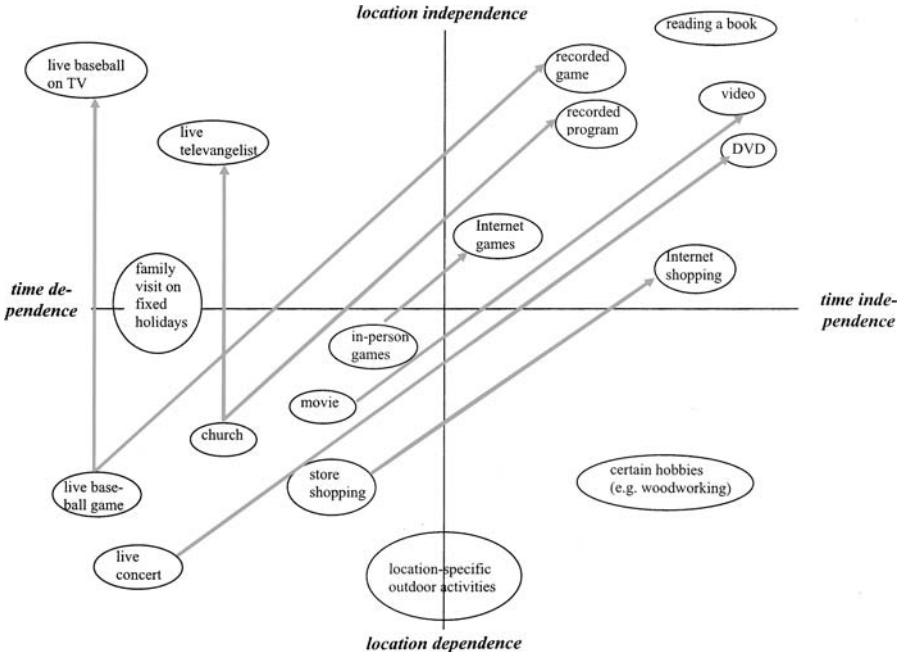

Figure 1. Spatial and temporal impacts of ICT on selected activities.

the action in real time, while not being there. Another possibility is to see the action in a time-independent mode via a recorded form. The three types of leisure activity, that of ''being there,'' ''being there temporally but not physically'' and ''sharing the activity at a different time and place'' constitute very different experiences, as noted by Katz and Dayan (1985).

For substitution to take place, the availability of an ICT-based alternative is a necessary (though not sufficient) condition. We believe that such availability is often not nearly as extensive as some would expect. For example, in a study of one week of activities conducted by each of 398 residents of Toronto, Canada in 2002–2003 (comprising about 7000 activities altogether), Doherty (2003) found that fully 80% of them were reported to have only one location at which they could occur.[10] Temporal flexibility was higher: only about a quarter of the activities fell into the lowest range of a temporal flexibility indicator, while more than half fell into the highest range. Conversely, as noted in the Introduction, many ICT-based activities do not have a location-based counterpart as a practical alternative, but simply would not have occurred otherwise (e.g., listening to a recorded performance on the radio). These types of activities fall into Category 2.

The degree of time- and location-independence of an activity may influence the *choice set*, but does not determine *choice*. A number of studies

have investigated factors influencing the adoption of ICT activities such as telecommuting (Mokhtarian & Salomon 1996), teleconferencing (Button & Maggi 1994), and teleshopping (Salomon & Koppelman 1988). In general, adoption is a function of the relative advantages and disadvantages of the ICT-based versus location-based alternatives, taking into account (as mentioned earlier) that the individual may value a number of factors beyond the surface ones. Mokhtarian and Salomon (2002) suggest a generic utility function for evaluating such alternatives, including variables such as the quality of the information obtained and the social/psychological content of the alternative. These variables often favor the location-based form of an activity over its ICT counterpart. Several dimensions relevant to the choice context and the characteristics of the alternatives are presented in Table 2.

3.1.2. *Generation of new ICT activities*

ICTs offer opportunities for many new activities, such as playing games on a mobile phone. If individuals spend more time on ICT-based activities (whether leisure or not), it stands to reason (with the exception noted below) that they are spending less time on non-ICT-based activities (whether leisure or not; Nie et al. 2002). To the extent that the foregone activities involved travel, this effect, like the preceding one, may also reduce travel. Although the displacement may be immediate and conscious, it can also occur over longer periods of time and more subconsciously. In such cases, an individual may find it difficult to pinpoint exactly what activity has been "crowded out" by Internet use. As a result, the time displacement of other activities by ICT may be better captured by measuring longer-term trends in time use than by analyzing individual choices on particular occasions.

Available data indicate that Internet use and cell phone use have grown rapidly in recent years. Given these increases, two questions arise: to what degree have ICT-based activities crowded out other activities (and to what degree will they do so in the future), and which activities get crowded out (and will in the future)?

The degree to which ICT-based activities are chosen over other activities depends on the characteristics of ICT-based activities and the utility they provide relative to other activities. Characteristics that may tend to increase the utility of ICT-based activities include location independence, time independence, and fragmentability (see the dimensions summarized in Table 2). Utility will, of course, also depend on the technology. In general, as the technology improves, the utility of the activity will increase, and the potential for the ICT-based activity to crowd out other activities will increase.

Table 2. Relationships of leisure activity classification dimensions to types of ICT impact.

Types of ICT Impact	1. Replacement of Traditional Activity with ICT Counterpart	2. Time Displacement of Other Activities by ICT	3. ICT-enabled Reallocation of Time to Other Activities	4. ICT Facilitation of Other Activities
Dimensions				
1. Location (in)dependence	ICT partly relaxes location dependence; location-dependent activities less likely to be substituted by ICT.	Location independence of ICT increases its utility and may contribute to its crowding out more constrained activities.	To the extent the location independence of certain ICT applications increases their adoption, resulting time or money savings can lead to engagement in leisure and other activities.	Location independence of ICT may increase its use as a facilitator.
2. Mobile or stationary	Mobile activities less likely to be substituted by ICT (except e.g. in virtual reality training programs).			
3. Time (in)dependence	ICT partly relaxes time dependence; time-dependent activities less likely to be substituted by ICT.	Time independence of ICT increases its utility and may contribute to its crowding out more constrained activities.	To the extent the time independence of certain ICT applications increases their adoption, resulting time or money savings can lead to engagement in leisure and other activities.	Time independence of ICT may increase its use as a facilitator.
4. Planning horizon			ICT effects may be either medium-term (one plans to telecommute, in part to save time for other activities) or short-term (the time savings and/or the decision to reallocate it may arise spontaneously).	ICT facilitates the generation or modification of activities in both the short term (spontaneous meeting with friends organized by mobile phone) and the medium term (using the Internet to find holiday travel bargains).

Table 2. Continued.

Types of ICT Impact	1. Replacement of Traditional Activity with ICT Counterpart	2. Time Displacement of Other Activities by ICT	3. ICT-enabled Reallocation of Time to Other Activities	4. ICT Facilitation of Other Activities
Dimensions				
5. Temporal structure and fragmentation	ICT-based forms of activities are often more easily fragmentable, which may increase the utility of these alternatives.	Fragmentability of ICT activities may increase their utility and contribute to their crowding out more constrained activities.		Fragmentability of ICT activities may increase their utility as facilitators (making a mobile phone call "on the fly"; browsing the Net on a short break at work).
6. Ease of multitasking	ICT-based forms of activities often lend themselves more readily to multitasking, which may increase the utility of these alternatives against their traditional counterparts.	Ability to multi task sometimes means that ICT activities can be added without "sacrificing" others.		
7. Solitary versus social	ICT relaxes boundary between solitary and social activities, and may increase the utility of "virtually social" activities for otherwise solitary individuals.	ICT-based leisure activities can be solitary or social. Because the solitary ones are easier to conduct, those may be more likely to displace time from other activities.		Ability of ICT to facilitate spontaneous or short-notice meetings may increase time spent in social rather than solitary activities.
8. Active versus passive[13] participation	Active participation in physical activities less likely to be substitutable by ICT.	ICT may promote more active participation in mental activities (e.g. computer games).		
9. Physical versus predominantly mental	Mental activities more likely to be substitutable by ICT than physical ones.	Physical (or mental) activities can be crowded out by ICT.	The time freed up by ICT may be devoted (partly) to physical (or mental) activities.	ICT can facilitate the organization of physical (as well as mental) activities.

10. Equipment/ media (in)dependence	Among others, technological characteristics of the ICT alternative will influence its utility relative to traditional counterpart. Activities requiring non-ICT equipment or media may be less substitutable.	Among others, technological characteristics of ICT-based activities will influence their utility and hence the extent to which they are adopted and crowd out others.	Technological characteristics of ICT-based activities will influence their utility, hence the extent to which they are adopted, hence the extent to which they free resources for other activities.	Technological characteristics of ICTs will influence the extent to which they are useful as facilitators (e.g. coverage of mobile phone service; availability of wireless Internet).
11. Informal versus formal arrangements				ICT can facilitate making the necessary arrangements, perhaps even last-minute, and hence may increase the engagement in activities requiring such arrangements.
12. Motivation[14]	Quality of experience via the ICT alternative may be inferior on an important dimension (e.g. enjoyment of aesthetic production), and hence reduce its utility compared to traditional counterpart. Status motivation may involve conspicuous consumption, which may be perceived as higher with the traditional form (box seats at stadium v. watching on TV). But consumption of ICTs can also involve status.			
13. Cost	Relative costs of alternatives (balanced against relative benefits) will determine choice between ICT and traditional form.	Among others, cost of ICT-based activities will influence their utility and hence the extent to which they are adopted and crowd out others.	Cost of ICT-based activities will influence their utility, hence the extent to which they are adopted, hence the extent to which they free resources for other activities.	Cost of ICTs will influence the extent to which they are adopted as facilitators.

However, the multitasking ability that comes with many ICT-based activities means that increased time devoted to these activities does not necessarily crowd out other activities. For example, when students talk to friends on their cell phones while walking across campus, they do not reduce time devoted to other activities,[11] rather they do more with the time they have. The characteristics of location independence, time independence, and fragmentability also mean that ICT-based activities may get squeezed into the little blocks of time during the day that are too short or too inconvenient for other significant activities. In this case, ICT-based activities displace otherwise wasted time and also enable individuals to do more with the time they have.

Which activities will get displaced by increasing ICT use may vary considerably from individual to individual and from activity to activity. One might expect the activities most likely to be displaced over time to be those that offer rewards and satisfactions similar to those of the ICT-based activities that replace them. One might also hypothesize that the same kinds of activities that are more likely to be *replaced* by ICT versions of those activities, as described in the previous subsection, are also more likely to be *displaced* by increases in ICT-based activities more generally. But the characteristics of the displaced activity may not play as important a role in this case, given the unconscious nature of the displacement over time.

3.1.3. *ICT-enabled reallocation of time to other activities*

The use of ICT may reduce the time and/or cost required to conduct activity X (or the travel associated with X), with the saved time or money used (at least in part) to engage in activity Y. For example, the travel time saved by telecommuting or videoconferencing may be spent in part on leisure activities. The money saved by finding a low-cost last-minute airfare on the Internet may be spent on other leisure trips and/or activities. With respect to this category of impacts, relevant questions include: To what extent will time-saving ICT applications be adopted? How much savings will this mean? And how will the savings then be used?

As with the previous two categories, the extent to which time-saving ICT applications will be adopted depends on the characteristics of the ICT-based activities and the utility they provide relative to other activities. To the extent that the use of ICT in this context is a choice between two forms of the same activity (e.g., commuting versus telecommuting to work), considerations similar to those mentioned in Section 3.1.1 specifically for leisure activities apply.

The amount of time or money that is saved by a given ICT activity can depend on individual-specific characteristics (e.g., one's commute time, in the case of telecommuting) as well as on technology (e.g., how effective an on-

line "shopbot" is at identifying cost savings for a desired item). Savings may not always be realized at all (or may be negligible), even in situations where they might be expected. For example, some studies show little or no cost savings achieved by Internet shopping (Brynjolfsson & Smith 2000; Lal & Sarvary 1999).

The time or money saved by ICT applications can be applied either to more ICT-based activities, or to non-ICT based activities, and to activities in any of the three basic categories. Thus, time saved by telecommuting might be used to work longer (mandatory), to cook more elaborate meals (maintenance), or to throw a Frisbee with the kids (leisure). The new mix of activities will again depend on individual-, activity- and alternative-specific variables. The effect on travel is ambiguous, depending on whether the new activities involve new travel or not. The evidence for telecommuting in particular is that the net impact is substitution, i.e., that the non-commute travel generation effect appears to be negligible and in any case outweighed by the commute travel substitution effect (e.g., Mokhtarian 1998; Choo et al. 2005).

3.1.4. *ICT as enabler/facilitator/modifier of leisure activities*

Finally, the availability of ICT can facilitate activity generation and scheduling. For example, mobile phones permit an impulsivity of activity engagement (spontaneous arrangement of meetings; last-minute reservations) that was not previously possible (or at least not easy). By providing readily available information about an enormous variety of activity and travel opportunities, the Internet facilitates making the arrangements for holiday and business trips, and may offer price bargains that allow more travel[12] to be consumed within a given budget. The result is at least a more flexible activity engagement, and potentially engagement in more out-of-home activities and/or a greater variety of activities, than before. The impact on travel is likely to be modification in some cases (e.g., en route diversions in response to a mobile phone call), outright generation in others (organizing a social activity on the fly that would not have occurred without the mobile phone), and reduction in others (as when a phone call en route prevents one from driving around lost). Choo and Mokhtarian (2005) suggest that a statistically insignificant impact of number of cell phone subscribers on a composite indicator of travel demand in their aggregate time-dependent structural equations model could represent effects in both directions that cancel out on net.

As indicated in Section 3.2 below, ICTs have a number of characteristics that support their increasing popularity as facilitators: location independence, time independence, fragmentability, and multitasking ability. Currently, technological factors and cost are still barriers in many

circumstances, but these barriers are rapidly being eroded with further technological progress.

3.1.5. *Similarities and differences among the four types of impacts*
Figure 2 groups the four types of impacts in such a way as to illustrate similarities and differences among them. We see, for example, that Categories 1 and 2 have in common that ICT is in some sense the "end" – the basis of conducting the new activity itself. In Category 1 the ICT leisure activity directly *replaces* its traditional counterpart, whereas in Category 2 the ICT activity more indirectly *displaces* other activities through a reordering of one's time allocation priorities. In Categories 3 and 4, ICT is the "means" – the instrument by which other activities of interest are affected, rather than the affected activity itself. Categories 2 and 3 both involve a reallocation of one's time budget, with cross-activity effects (something about activity(ies) X affect(s) activity(ies) Y). In the case of Category 2, ICT (activity X) *takes* time from other activities (Y), whereas in Category 3, ICT (X) *gives* time (or money) that can be spent on other activities (Y), whether non-ICT or ICT, leisure or other. Category 4 is a case of activity generation or modification: activity X either would not have occurred at all without ICT (which is viewed in this context as being mainly the ancillary instrument rather than a separate activity), or is materially changed by it. Category 1 is a case of direct or own-activity substitution, in contrast to the cross-activity substitution effects of Categories 2 and 3.

To fully understand the leisure-related impacts of ICT, it is important to consider all of these types of effects. While it may be tempting to focus on modeling the choice between ICT- and location-based forms of an activity (Category 1) because it is relatively straightforward to do so, for example, that may not constitute the largest impact of ICT on leisure travel. In truth, we do not know at this point the magnitudes or even the rank-ordering of the travel impacts of these four types of effects. There is fertile ground for further research.

3.2. *ICT and relevant dimensions of leisure*

From the diverse list of dimensions available to classify leisure activities, we have identified 13 that seem to us to be the most ICT-"sensitive" (Doherty 2003 uses some of these same dimensions to characterize any type of activity). These dimensions can be grouped into five types: location (1 and 2), time (3–6), social context (7–8), traits intrinsic to the activity (9–11), and the benefit/cost tradeoff (12 and 13). For the sake of brevity, we forgo discussing each dimension in depth (such a discussion is available in Mokhtari-

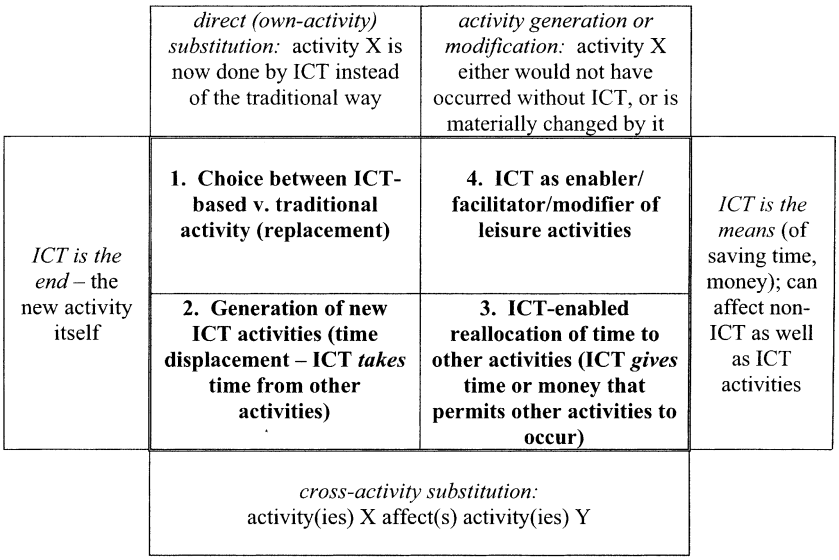

Figure 2. Relationships among types of ICT impacts.

an et al. 2004). Rather, Table 2 summarizes the relationships between the four types of ICT interactions introduced in Section 3.1, and each of the dimensions. Although some blank cells of Table 2 could be filled in, those relationships seem less likely and/or less important than the ones that are included.

In summary, most of these dimensions can be categorized as being ICT-sensitive, meaning that the introduction of ICTs may have significant impacts on the way people perceive leisure activity options and use. The two most directly relevant attributes from a travel behavior perspective are the impacts on time and space, but all are relevant to travel to the extent that they influence the adoption of ICT activities, which in turn have travel implications.

4. Conclusions

In this conceptual discussion of the potential impacts of ICT on leisure activities and travel, several recurring themes emerge. One theme is that a key role of ICT is to expand the individual's choice set, both of activities and of ways to conduct a given activity. Among new ICTs, clearly the mobile phone and the Internet are having the largest impact on activity patterns. At present, the Internet is perhaps more important in the United

States and the mobile phone more important elsewhere in the world, but both technologies are still spreading, as well as merging in forms such as the Web-enabled mobile phone, voice-over-Internet applications, or personal digital assistants (PDAs) with wireless Internet connections.

Another recurring theme, however, is that just because new choices are available, there is no guarantee that people will choose them. The appeal of ICT-based activities will depend on characteristics of the choice context, the alternatives, and the individual. We are reminded that in many cases, ICT does not offer a satisfactory alternative to traditional ways of conducting activities. And in fact, although we have generally assumed the availability of ICTs in the foregoing discussion, that assumption is not universally true. In some cases a desired ICT is not available to *anyone* – being technologically or economically out of reach at this point – and in other cases it is available to some people but not to *everyone*. Obviously availability is a necessary, though not sufficient, condition for an ICT alternative to be chosen. Following the interesting results of Doherty (2003) with respect to the spatial and temporal flexibility of activities (discussed in Section 3.1.1), it would be valuable to monitor the extent to which that perceived flexibility is changing over time, as well as simply the extent to which ICT alternatives are perceived to be available. Further, the differential availability of ICTs to different geographical locations and socio-economic segments of society is a matter of policy concern as well as research interest.

A further overarching observation is that the potential leisure-related impacts of ICT on travel are mixed. For some types of effects (Categories 1 and 2 of Table 1 and Figure 2) the adoption of ICT is likely to reduce travel; for others (Categories 3 and 4) the primary effect is likely to be generation of new travel, although secondary modification and substitution effects are also likely. We do not know the net outcome of these complex and counteracting relationships, nor even a rank ordering among the various types of ICT impacts with respect to their implications for travel.

In addition to those already expressed or implied, a number of directions for further research have been suggested by this discussion. One fundamental question worth exploring is, how do people perceive leisure? That is, what qualifies an activity as leisure or not-leisure to a given individual, and with what factors does that classification vary across people? Besides being of theoretical interest in their own right, from a practical standpoint the answers are important to our ability to craft empirical studies in a way that will be meaningful to the participants, even – or perhaps especially – if our desired definition differs from theirs (see Passmore & French 2001 for one example of such a study).

With respect to each of the four types of ICT impacts identified in this paper, two generic questions can be raised: (1) What is the extent of the adoption of the relevant ICTs (whether they are the ends of interest as in Categories 1 and 2, or the means to another end as in Categories 3 and 4); and (2) for a given level of adoption of ICTs, what is the nature and extent of their impacts on the targets of study? For a study of Category 1 adoption (the choice of an ICT-based versus traditional way of conducting a given activity), discrete choice models probably constitute the logical analysis methodology. For adoption within the other three categories, the natural paradigm is not so much that of an either-or choice among discrete alternatives, but rather a shift in the way one's time is allocated. Accordingly, appropriate analysis methodologies could include utility maximization based models of time allocation (see, e.g., Kraan 1997), structural equations models (e.g. Lu and Pas 1999), and/or duration models (Bhat 1996).

The questions raised in this study can be approached through several different kinds of data collection instruments. Panel-based time use diaries are the logical means for addressing how individuals' allocation of time is changing over time, as well as the implications for travel (see Nie et al. 2002 for a diary-based methodology that reduces the burden imposed by a standard 24-h time use diary, and for their finding that "displacement" dominates "efficiency" as the main effect of Internet use). Such surveys would ideally be somewhat customized to this application, including questions about the spatial and temporal flexibility of each activity (per Doherty's work), a fine-grained resolution of ICT-based activities, and careful assessment of the extent of multitasking (particularly where ICTs are involved). Other questions, such as "what constitutes leisure," probably require specialized surveys and/or qualitative approaches such as interviews and focus groups, although a time use or activity diary could also be designed to inquire about the degree of "leisureness" perceived for each activity. Similarly, analyses of the choice between ICT- and location-based alternatives will generally require specialized questionnaires, collecting information on the availability and the perceived advantages and disadvantages of each alternative on all relevant dimensions, as well as on characteristics of the individual and the choice context.

In sum, the study of the impacts of ICTs on leisure activities and travel presents a number of interesting and important challenges to the profession. We look forward to the further development of this rich and rewarding topic.

Notes

1. In this paper we take a broad view of what constitutes ICT, including "old" technologies such as radio, television, telephone, and fax as well as "new" technologies such as laptop computers, mobile phones, and the Internet. We do so not only because both types of technologies can affect activity and travel patterns, but also because the boundaries between old and new (e.g., radio and Internet) are often blurry.
2. ICT can also affect the demand for travel by affecting the supply, as with various Intelligent Transportation System (ITS) applications. To the extent that ICT facilitates more efficient use of the transportation system, the cost of traveling is reduced and more or longer trips to activities may result. The primary focus of this paper is the effects of ICT on the demand for activities and their associated travel, directly. However, indirect effects on demand through improvements in supply can fall under the third category of ICT impacts, discussed in Section 3.1.3.
3. Anable (2002, p. 181) comments that leisure "represents one of the only journey purposes with essentially universal participation", and Götz et al. (2002) found that there was less variability across lifestyle clusters in the time devoted to leisure activities than in the time spent on non-leisure.
4. There are exceptions: some leisure activities undertaken out of duty to other people (see discussion below) may occasionally be outsourced, as when we get someone to take our place at a social or entertainment event we really do not wish to attend.
5. For similar views on the social-psychological fulfillment aspects of work, see Csikszentmihalyi and LeFevre (1989) and Tschan et al. (2004); see Lewis (2003) for a thoughtful and balanced discussion of whether professional knowledge work is "the new leisure." For a divergent perspective, in which "exciting and strenuous" leisure pursuits are chosen in deliberate contrast to "boring and sedentary" jobs, see Kernan and Domzal (2000, p. 97). In a lighter vein, Mark Twain (1835–1910) writes in *A Connecticut Yankee in King Arthur's Court*, "... there isn't money enough in the universe to hire me to swing a pickaxe 30 days, but I will do the hardest kind of intellectual work for just as near nothing as you can cipher it down – and I will be satisfied, too. Intellectual 'work' is misnamed; it is a pleasure, a dissipation, and is its own highest reward. The poorest paid architect, engineer, general, author, sculptor, painter, lecturer, advocate, legislator, actor, preacher, singer is constructively in heaven when he is at work; and as for the musician ... why, certainly, he is at work, if you wish to call it that, but lord, it's a sarcasm just the same" (Chapter 28, see, e.g., http://www.mtwain.com/A_Connecticut_Yankee_In_King_Arthur's_Court/29.html).
6. Whether constantly being "on call" is a *desirable* condition is of course debatable, and probably differently desirable for different people. Our point is simply that it is a *reality* for many people, with real implications for travel.
7. The boundary between this category and the preceding one is also blurry, technically depending on whether the interspersed activity fragments occur one at a time, or overlap. In practice it can be difficult to make this distinction, depending in part on the time scale at which activities are distinguished. A 10-min Internet shopping episode at work could be distinguished separately (constituting sequential interleaving) if the time scale were in minutes, but would be considered multitasking (a secondary activity overlapping the primary activity of work) if the time scale were in hours.
8. It is worth noting that this classification can apply to the effects of ICT on all activities, not just leisure, and to any number of technological improvements, not just ICT. For some technologies (e.g., microwave ovens), the time savings-effect (Category 3) may dominate the time-stealing effect (Category 2), and in some cases the facilitation effect (Category 4) may be inconsequential. But for a technology such as the automobile, all four effects are quite relevant.

9. Although this is true in a narrow sense, the ability of ICT to facilitate information-seeking and transactions (discussed further in Section 3.1.4) can broaden the choice set to include a larger class of "similar" locations. For example, instead of limiting one's choice set of "great mountain climbing locations" to the Alps and the Rockies, browsing the Internet may expand it to include the Himalayas, the Andes, the Pamirs, the Karakoram, the Kunlun, and so on. The result is, in a broad sense, greater location independence.
10. Perhaps this figure was 95% a few years ago, and will be 70% in a few years. ICTs clearly are releasing some spatio-temporal constraints. Thus, we should not underplay this effect, but we should keep it in proper perspective.
11. Although it can be argued that they do, in fact, reduce time devoted to previously overlaid activities such as interaction with one's surroundings and undirected contemplation. Different people will value this "lost" time differently.
12. Technically, to fall into this category the cost savings should result in choosing a more distant destination for a trip that was planned in any case. If the cost savings for one trip (or other purchase) is applied toward purchasing other trips or goods, it is an example of the third type of impact of ICT, discussed in the immediately preceding subsection.
13. Here, we do not use "active" to refer purely to physical involvement or to movement (dimension 9 makes that distinction), but rather to "engagement in an activity (whether physical or mental) in a way that affects the outcome". Thus, one can be an active participant in a bridge game, rather than a passive observer.
14. We suggest that the motivations for conducting a given leisure activity can include one or more of the following six conceptual types: physical exercise (as active participant or passive spectator, where the latter refers, e.g., to the motivation of enjoying watching the skilled execution of physical activities by others); mental exercise, learning (as participant or spectator); aesthetic or creative production (participant, spectator); socializing; status or self-identity enhancement (e.g., Kernan & Domzal 2000); or relaxation, escape. For each of these types (with the exception of the last one, which would normally be associated only with enjoyment), the motivation can further be one of *enjoyment* (in which the leisure activity is valued as an end in itself), or of *necessity/expectation* (in which the ctivity is a means to the end of fulfilling a duty or satisfying an expectation).

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